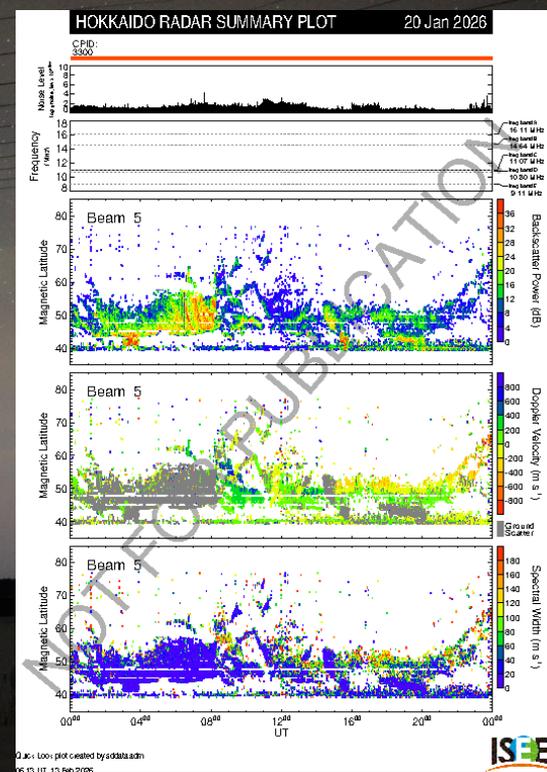# Status Report of SuperDARN HOP (Hokkaido Pair of) radars

SuperDARN HOPレーダーの現況報告

[1]N. Nishitani and [1] T. Hori

[1] ISEE, Nagoya Univ.

Low latitude aurora behind the SuperDARN HOP East radar (2026.01.21 0111 JST)
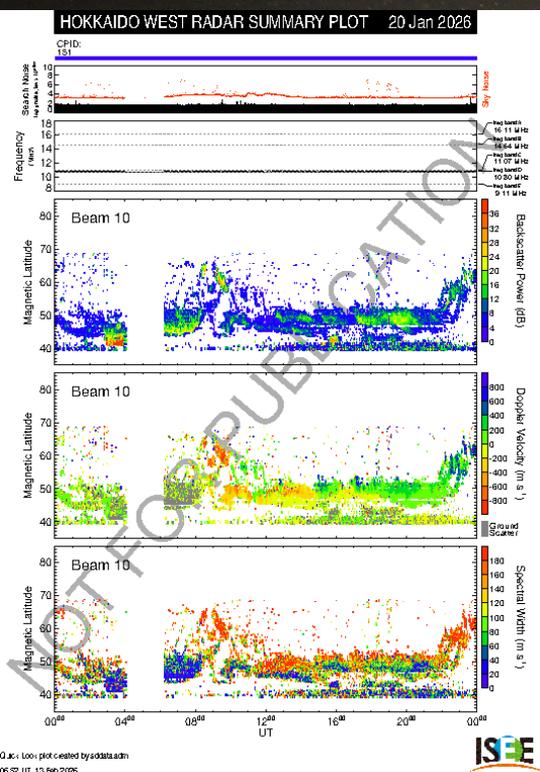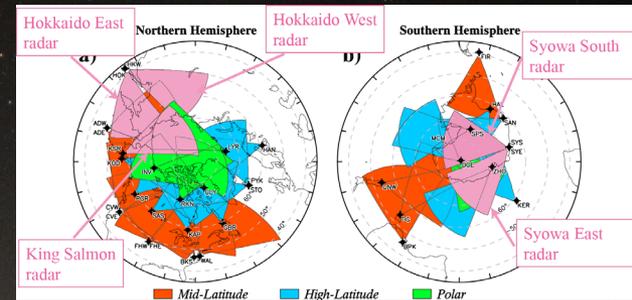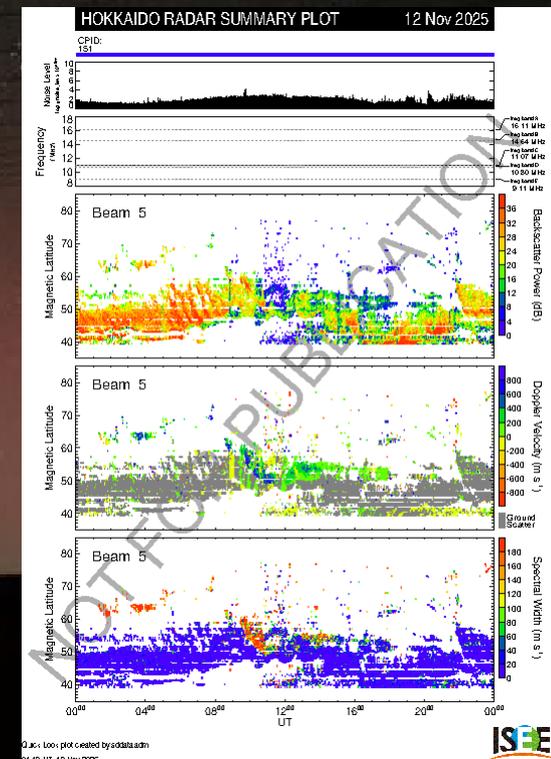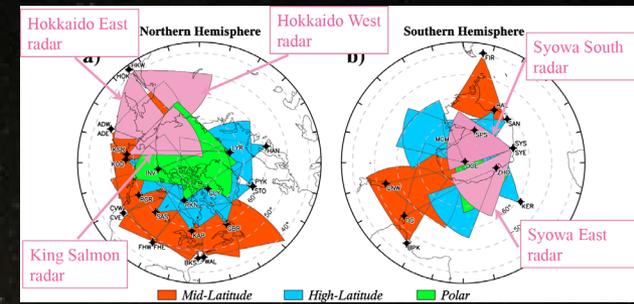
Status Report of SuperDARN HOP (Hokkaido Pair of) radars
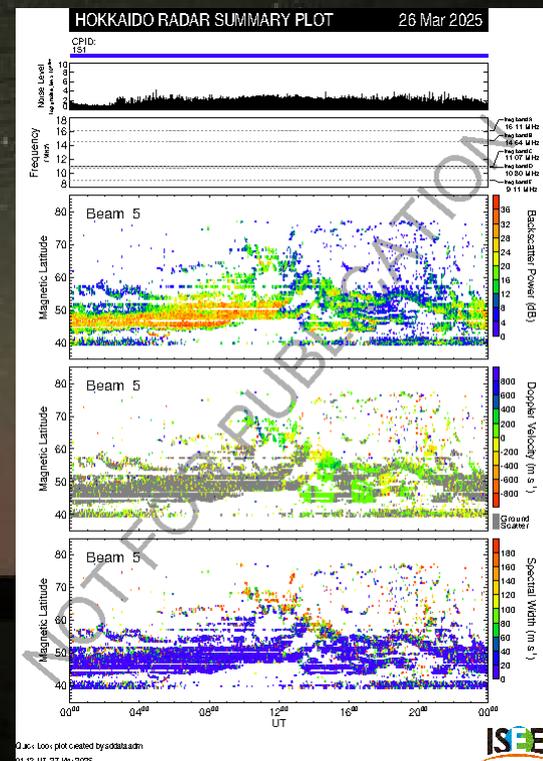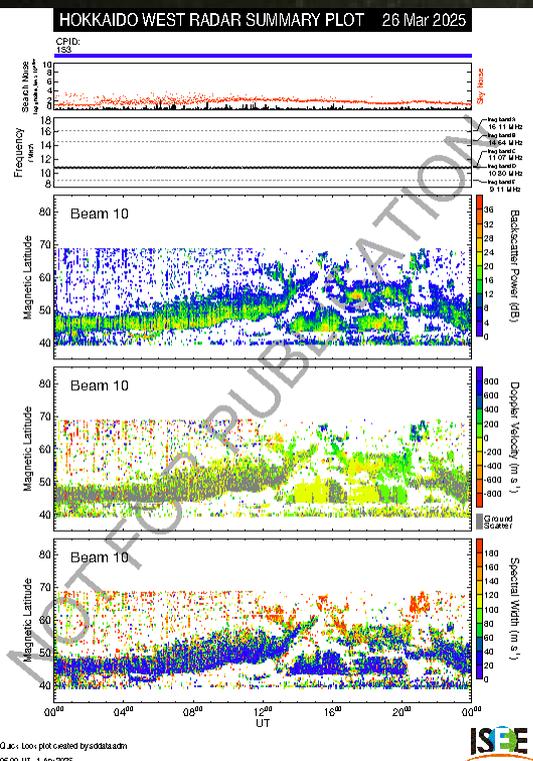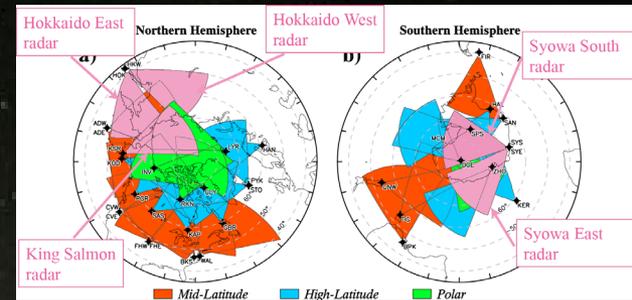
[1]N. Nishitani and [1] T. Hori

[1] ISEE, Nagoya Univ.

Low latitude aurora behind the SuperDARN HOP East radar (2025.11.12 1944 JST)

RIK 2025/11/12 19:44:03

Status Report of SuperDARN HOP (Hokkaido Pair of) radars

[1]N. Nishitani and [1] T. Hori

[1] ISEE, Nagoya Univ.

Low latitude aurora behind the SuperDARN HOP East radar (2025.3.26 2237 JST)

RIK 2025/03/26 22:37:05

Super Dual Auroral Radar Network (SuperDARN)
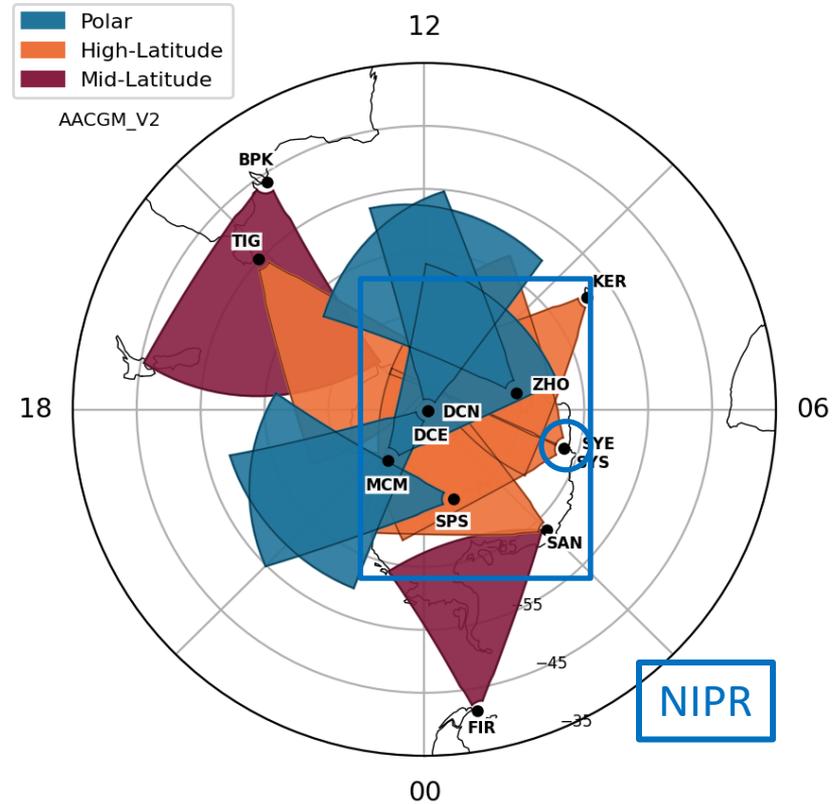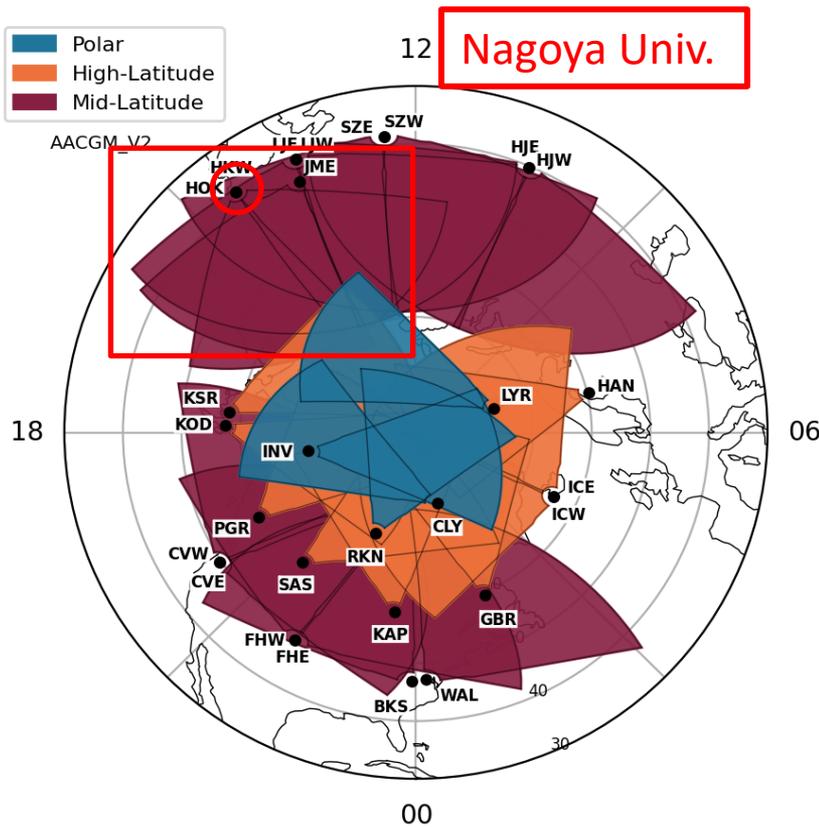
Number of operating HF radars: 38 (24 in the northern and 14 in the southern hemi-spheres) as of Feb 01, 2023, operated under the cooperation of about 10 countries

The radars use basically the same hardware architecture, same operation software, same schedule, same data format and same data analysis software, provide important information for the space weather / geospace dynamics studies.

26 Aug 2018, SuperDARN convection map

Bx

By

Bz

V_{sw}

ρ_{sw}

AU

AL

SYM/H
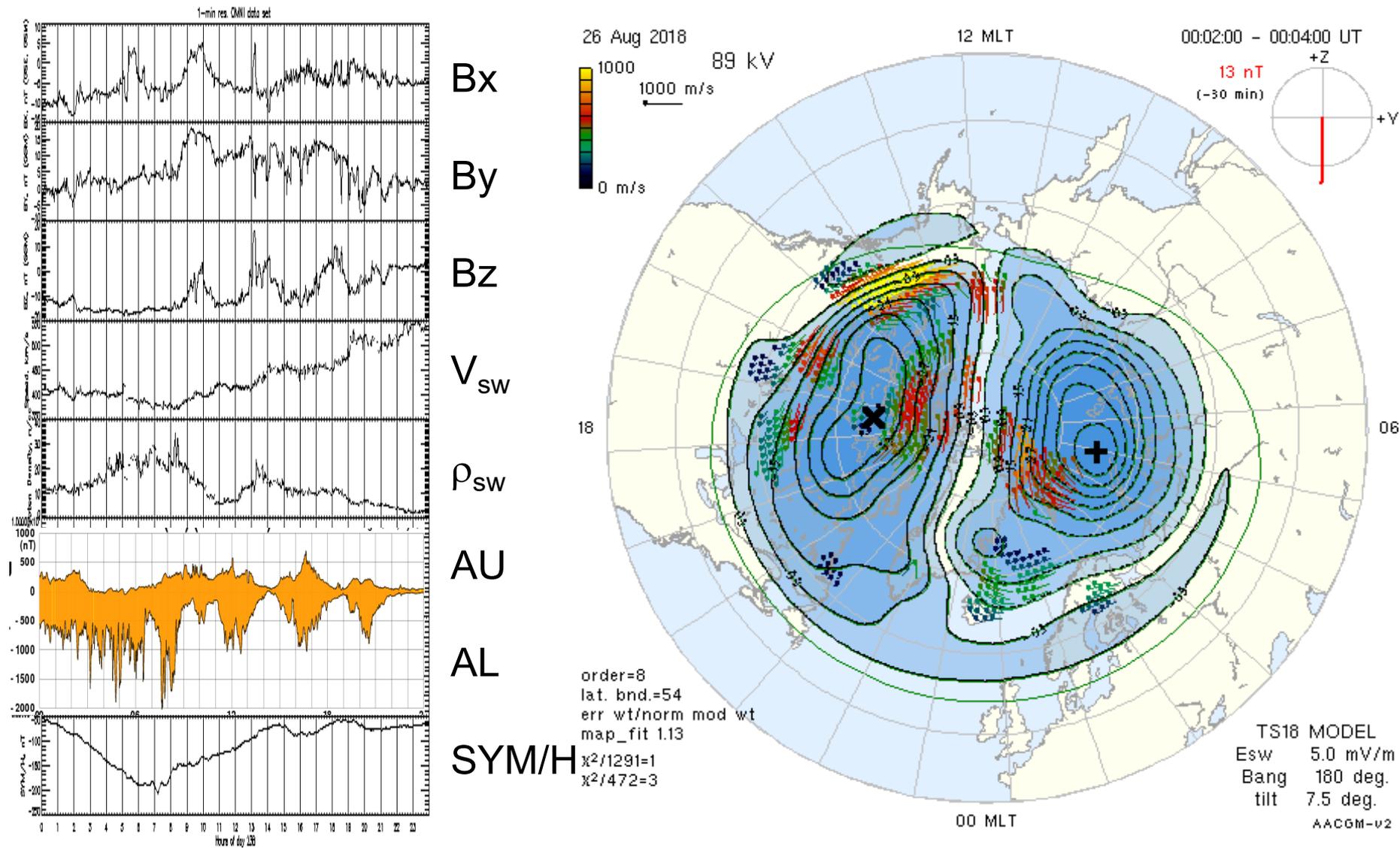
Importance of studying the distribution of ionospheric convection on a global scale, not only in the polar region but also in the subauroral region.

Airglow imagers

OI 630-nm emission
22/05/1998   23:10 JST

arb.intensity

GPS

23:10 JST   May 22, 1998   TEC [10^16/m^2]
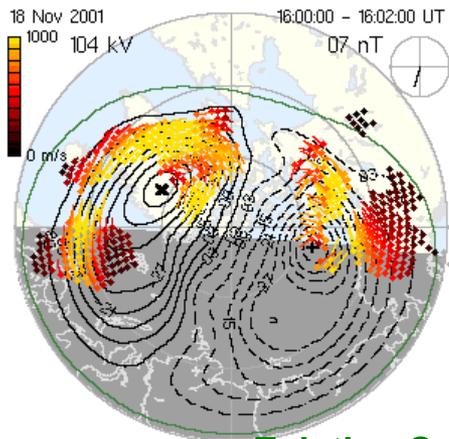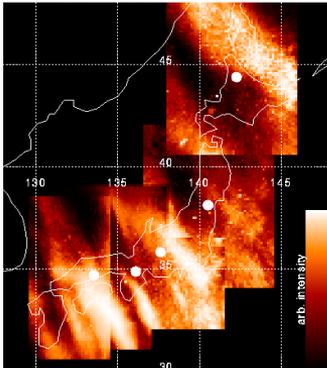
Existing SuperDARN network
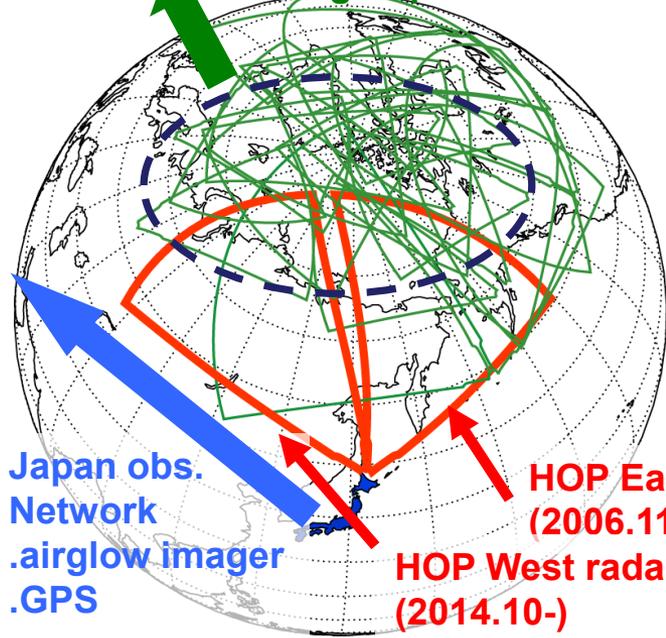
Japan obs.
Network
.airglow imager
.GPS

HOP East radar
(2006.11-)

HOP West radar
(2014.10-)

プラズマ対流

電離圏プラズマ

熱圏大気

中間圏エコー

重力波の伝搬
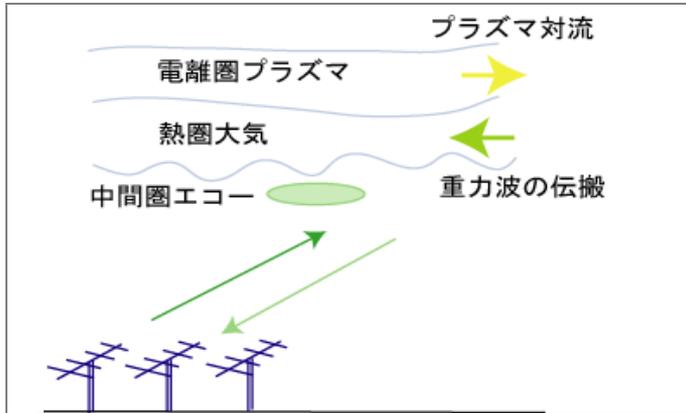
Study of ionosphere, thermosphere
and upper mesosphere

Unified understanding of the dynamics of the high- to 会
mid-latitude upper atmosphere

6
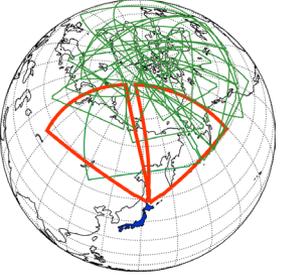
Recent updates of
the SuperDARN HOP radars

- Visit to the radar site (Sep 1-4). HOK R1 antenna was faulty but it was fixed by Abe Tsuushinsetsubi in November 10-15 (happened be during a Hokkaido aurora event!). Checking of all the antennas were made.

- All the other antennas were working properly, without serious problems.

- A few HKW transmitters looked faulty (V/F and REL error lamps were on).

- Onsite testing of implementing a full imaging capability at the HOK radar was successful (Dec 2025, Hamaguchi-san)

- The network to the radar site often becomes faulty. We are planning to switch to the mobile network connection (a mobile phone relay antenna nearby the radar site is now under construction). Attempt to set up a wired optical cable to the radar site failed.
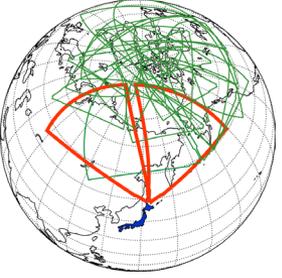
Recent updates of the SuperDARN HOP radars (cont.)

- After the visit to the radar site in February 20-21, the HKW radar started almost perfectly, after the re-installation of the chB Phasing matrix and Tx/Rx switch!

- In contrast, the HOK radar has been stopped since February 23 after a recovery from an unexpected electric power outage. So far, we have identified that the problem presumably lies in the phasing matrix unit. Yokozeki-san found that the DC power, which is supposed to generate +5v voltage, generates only 0.5v. We ordered the spare power supply and are waiting for its arrival in Japan (presumably March 11) before I go to the site again during March 16-19.

HOP radars archive (2025.01-2026.03)

Antenna maintenance

Network trouble (Jun 2025)

名大東山キャンパス停電
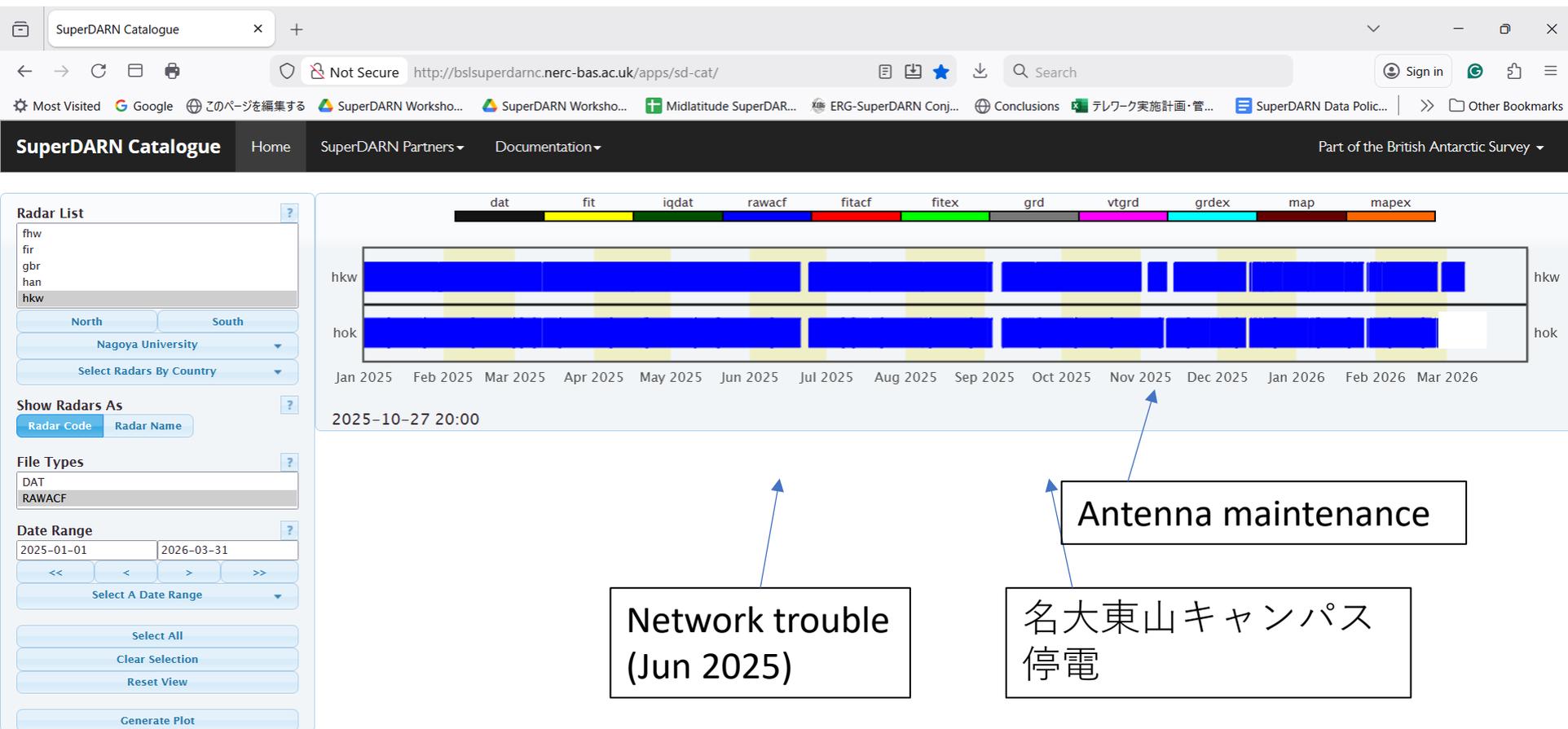
Implementation of imaging capability on some of the SuperDARN radars

- Several SuperDARN groups, including Nagoya Univ. (HOP East), are working on the plan of implementing a receiver on each antenna input and making post beam forming, so that temporal and spatial resolutions are improved by several times.

- There is still no standard way to achieve this.

- After the completion of such implementation, a new issue arises – how to handle / distribute a huge amount of data?
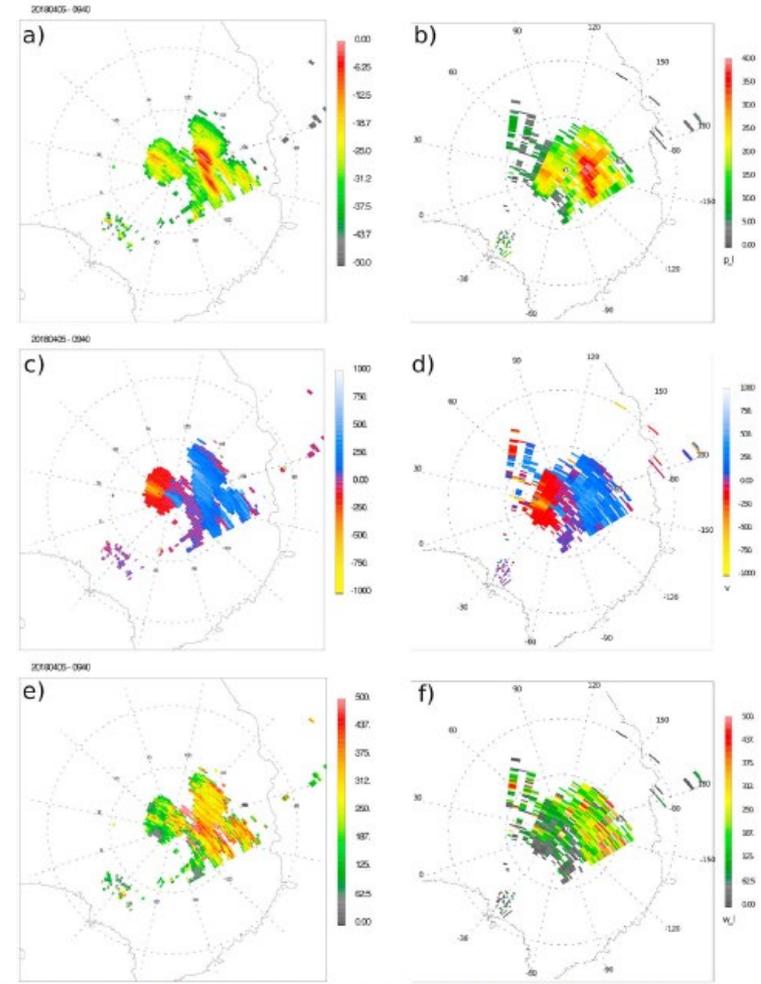
Figure 9. Left column shows imaging analysis, and right column shows standard Super Dual Auroral Radar Network processing of the same observations from the McMurdo radar at 0940 UT on 5 April 2018. The top row (panels a and b) shows signal-to-noise ratio, the middle row (panels c and d) shows velocity in meters per second, and the third row (panels e and f) shows spectral width in meters per second.

Bristow et al., RS, 2019

Imaging (multibeam) data / traditional data Billett et al. (2025, Earth Space Sci.)

Narrow-beam scanning

Wide-beam imaging

Imaging capability

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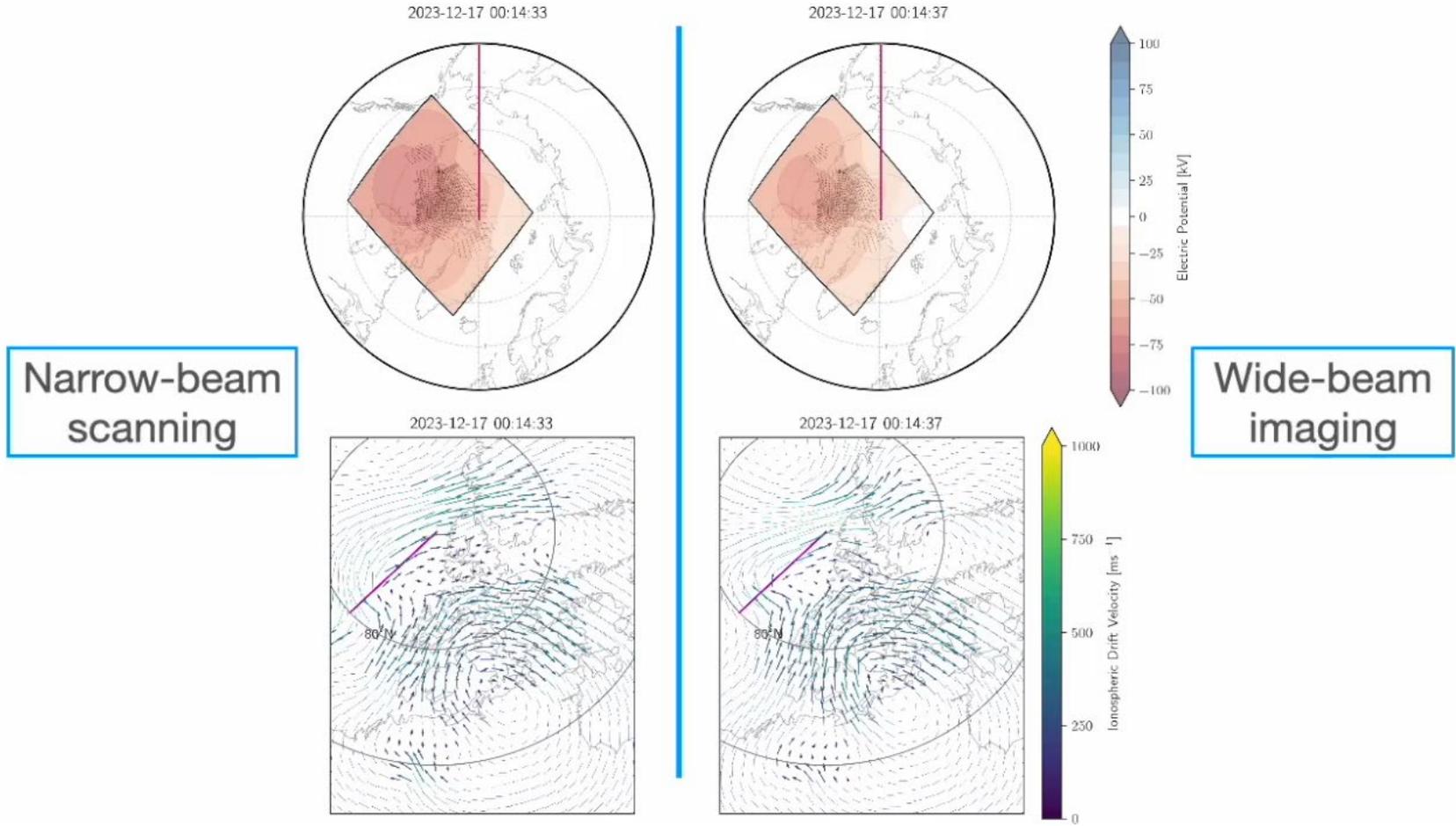
Production of the full 20-ch system

- We obtained Kakenhi Kiban-B (22H01284, 2022-2026 FY) for producing and operating the full 20-ch (16 main array + 4 interferometer array)imaging system at HOK (SuperDARN Hokkaido East).

topic	FH2022	FY2023	FY2024	FY2025	FY2026
イメージング受信装置製作・設置	←——————————→				
各種短周期変動現象の解析		←—————————————————————→			
人工衛星データ・地上観測データとの比較		←—————————————————————→			
成果のまとめ				←————————→	

Plan of installing full-spec imaging receivers

SuperDARN
Hokkaido East HF radar

20ch

HF radar body

(Main computer
 and Timing
computer)

Branch and amplifier → Phasing matrix

Branch and amplifier

20ch

Branch and amplifier

Frequency,
Time information

USRP N210

USRP N210

HUB

Host PC

Data processing PC?

USRP N210

Image of Imaging RX
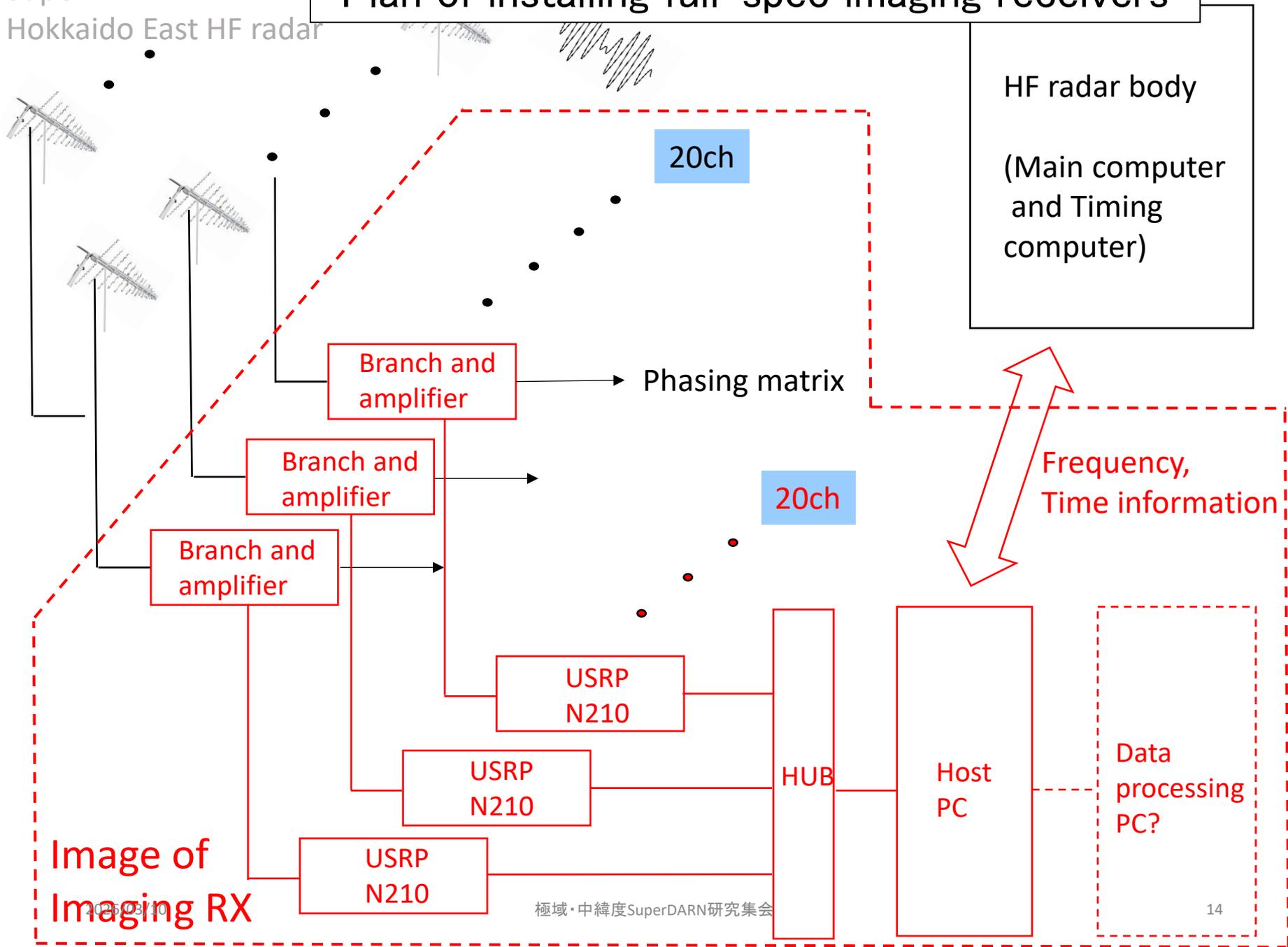
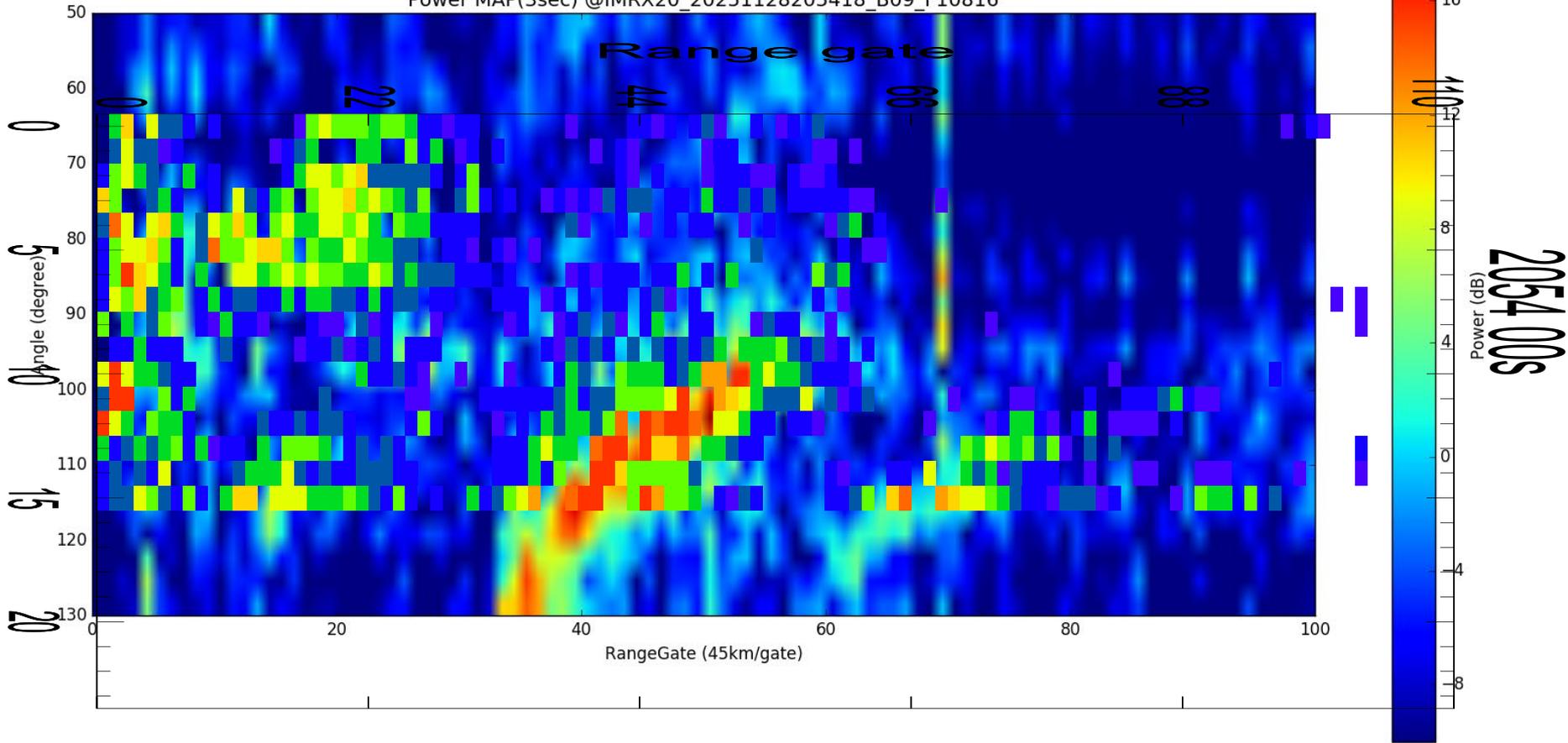# HOK 20-ch Imaging system: first light (Nov 28, 2025 2054:18 UT),Tx beam 9 (narrow) (PWR, 3-second integration)
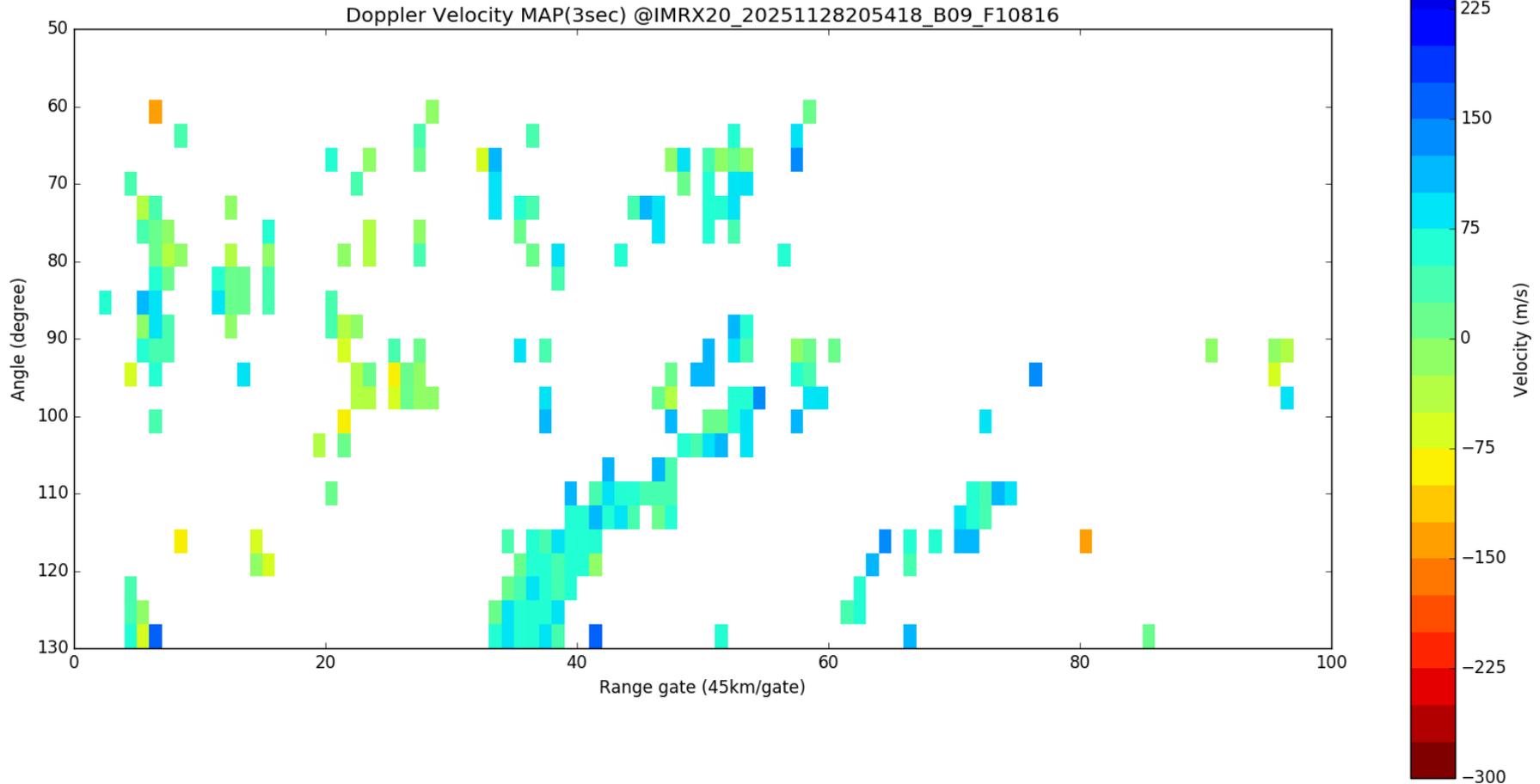
See Hamaguchi et al. presentation for details

Power MAP(3sec) @IMRX20_20251128205418_B09_F10816

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HOK 20-ch Imaging system: first light (Nov 28, 2025 2054:18 UT),Tx beam 9 (narrow) (VEL, 3-second integration)

See Hamaguchi et al. presentation for details

Doppler Velocity MAP(3sec) @IMRX20_20251128205418_B09_F10816

Application of Wide-Beam Transmission for Advanced Operations of SuperDARN Borealis Radars in Monostatic and Multistatic Modes
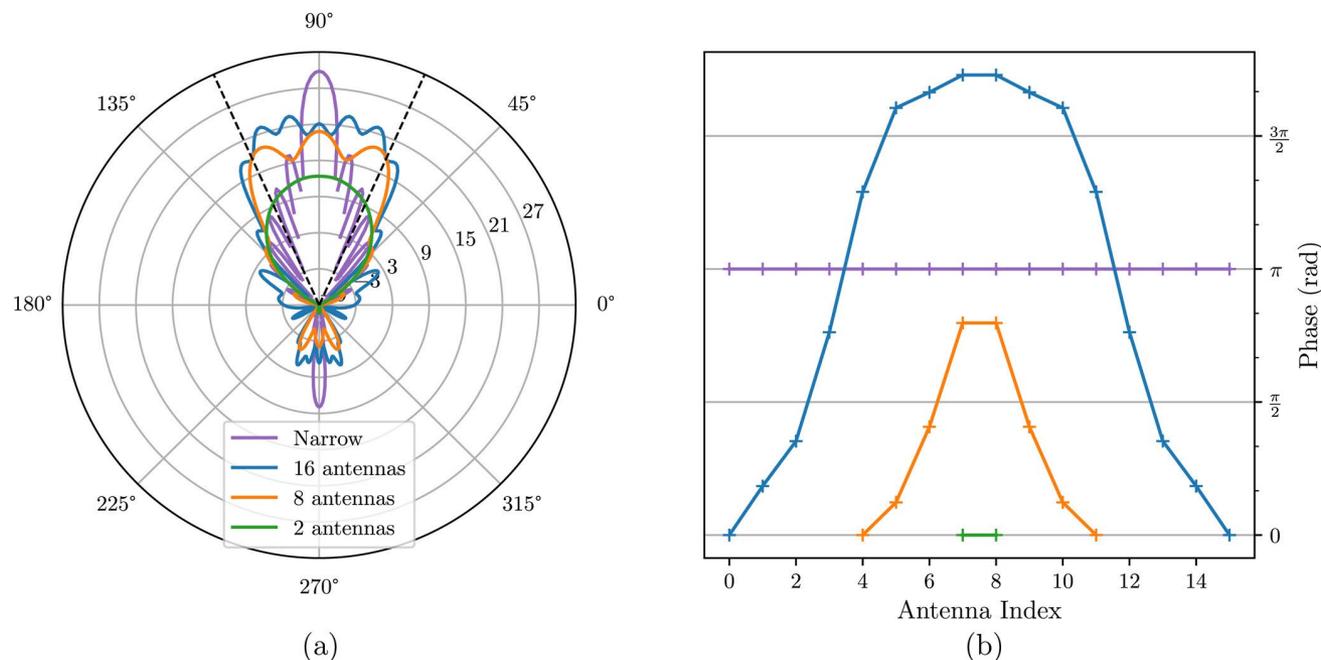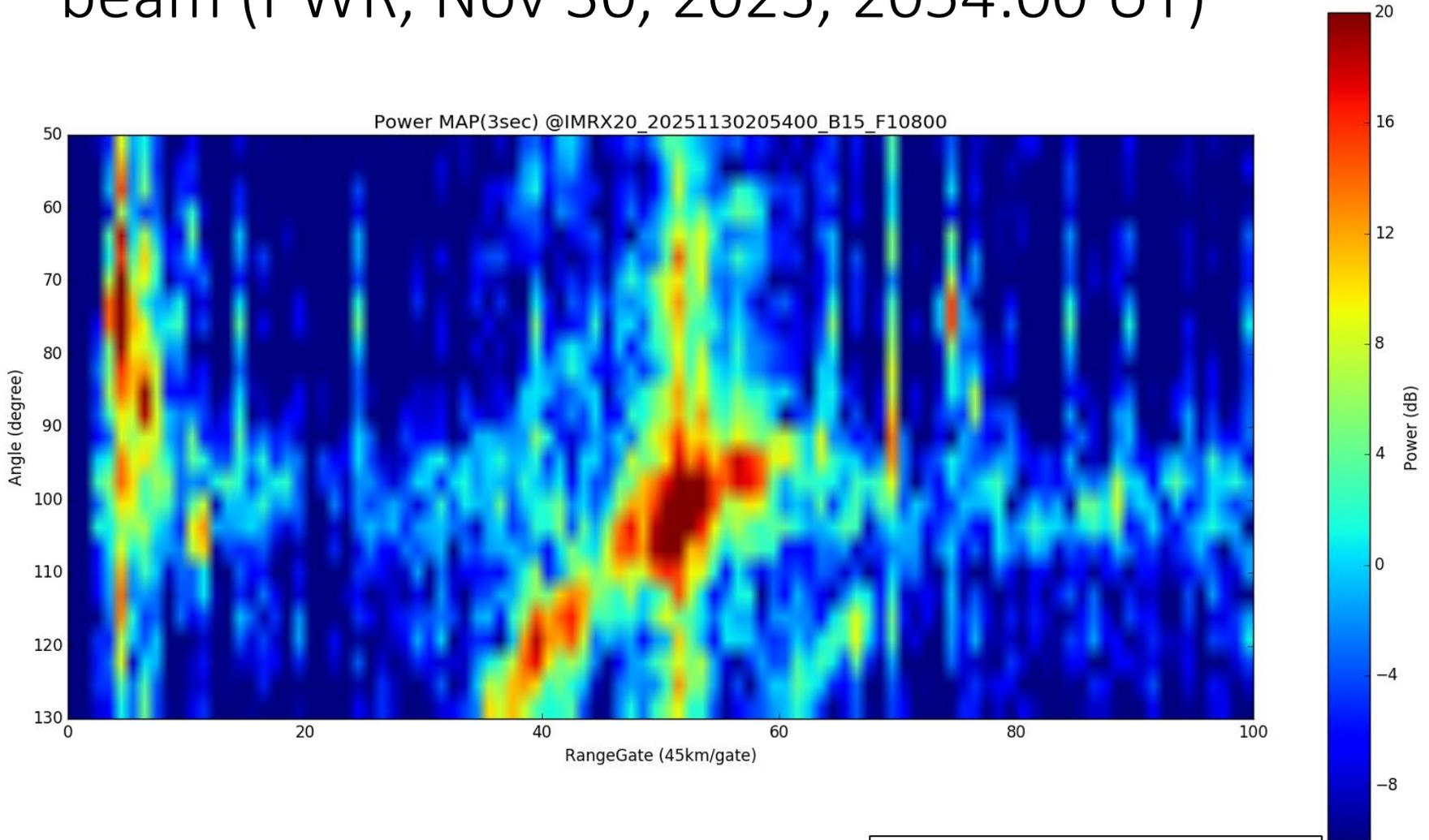Rohel et al., Radio Sci., https://doi.org/10.1029/2023RS007900, 2024.

Figure 1
(a) Directivity in dB relative to an isotropic source at an elevation angle of 35° for 16-antenna (blue), 8-antenna (orange), and 2-antenna (green) wide-beam modes, as well as for the conventional 16-antenna narrow-beam mode (purple). (b) Phase progressions across the antenna array used to generate the patterns in (a). The phase progression for the conventional pattern has been shifted up by π rad to distinguish from the phase progression for the 2-antenna mode.

Hamaguchi-san found that similar beam pattern can be generated by changing the order of PM-Tx cable connection (sacrificing the preexisting radar data). Please listen to his talk for details.

Imaging receiver data using (relatively) wide beam (PWR, Nov 30, 2025, 2054:00 UT)

Power MAP(3sec) @IMRX20_20251130205400_B15_F10800

See Hamaguchi et al. presentation for details

Imaging receiver data using (relatively) wide beam (PWR, Nov 30, 2025, 2054:00 UT)

Doppler Velocity MAP(3sec) @IMRX20_20251130205400_B15_F10800

See Hamaguchi et al. presentation for details
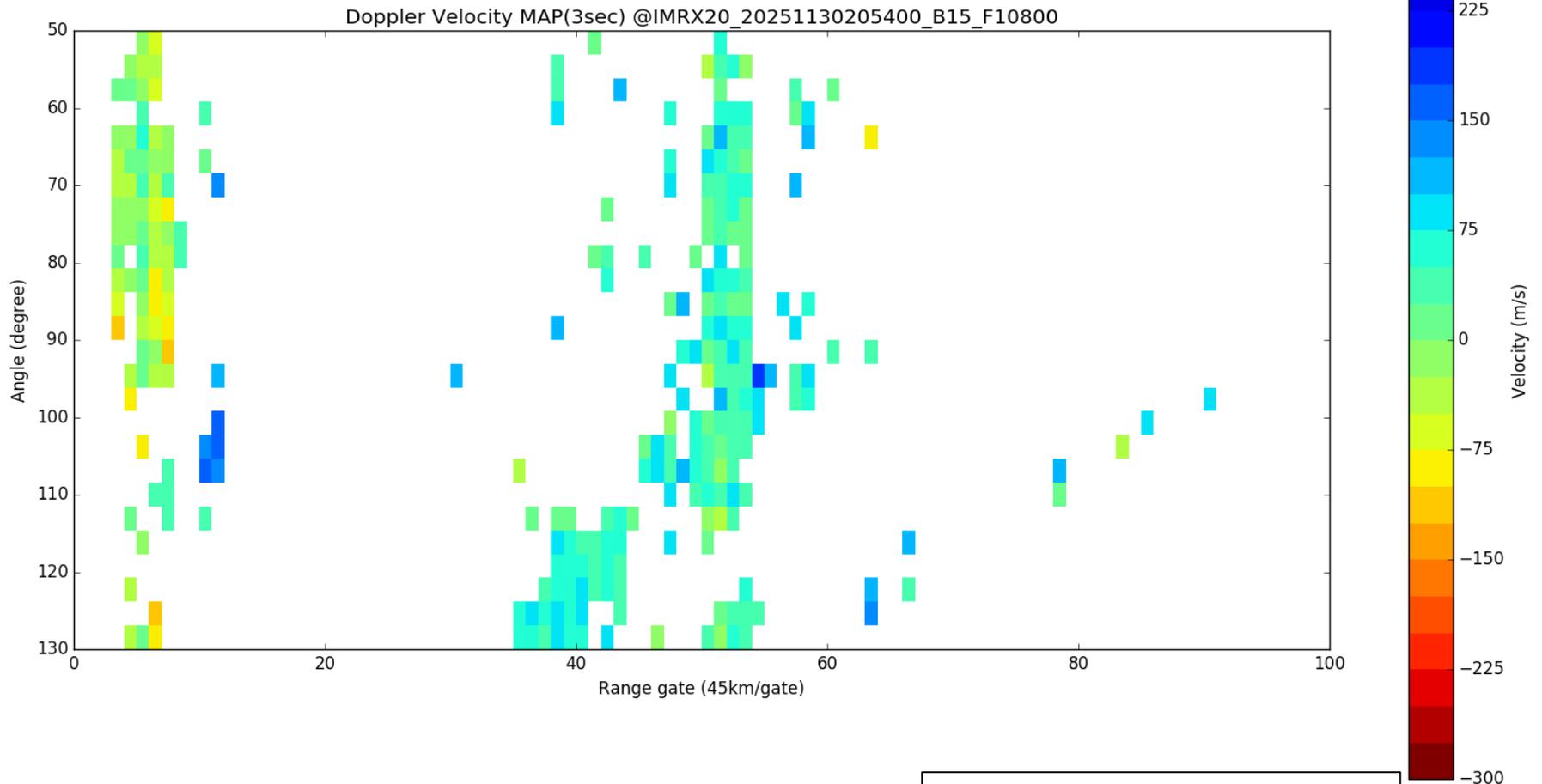
Summary

- The SuperDARN radars are powerful tools for studying a wide variety of phenomena in the geospace (including ionosphere and upper atmosphere) in the high- and mid-latitude regions.

- Nagoya Univ. group is implementing a next-generation imaging receiving system using the USRP units (on-site test using the 20-ch full set was successfully conducted on Nov 28-Dec 03).

- This imaging receiver system installed at the mid-latitude SuperDARN radar will be very useful for studying short time scale phenomena such as SCs, MHD waves / disturbances, ionospheric disturbances originating from the lower atmosphere, and the solar flare effects on the ionosphere.

- We will work on the transmitter side to master how to freely change the beamwidth. Then, we will bring the system set again to the site as the final version.

2026/03/10

Summary

- SuperDARN HOP radars have been working throughout the last 1 year. The HKW radar recovered its full power after February 20, whereas the HOK radar has been stopped since February 23. We are trying to solve the HOK problem.

- Imaging receiver full system testing at the radar site in early December was successful.

- The network to the radar site has several problems.

- Recent research activities
  - Hayamizu et al., Development and evaluation of imaging radar data processing/analysis software
  - Yoda et al., ionospheric convection associated with low-latitude auroras
  - Hashizume et al., Study of HF radio wave propagation characteristics using ham radio receiver signal coming from the SuperDARN Hokkaido East Radar
  - Kakoti et al., ionospheric responses to solar wind dynamic pressure changes using SuperDARN and other data
  - Nishitani et al., Ionospheric disturbances following 2025 July Kamchatka Earthquake (Mw=8.8)

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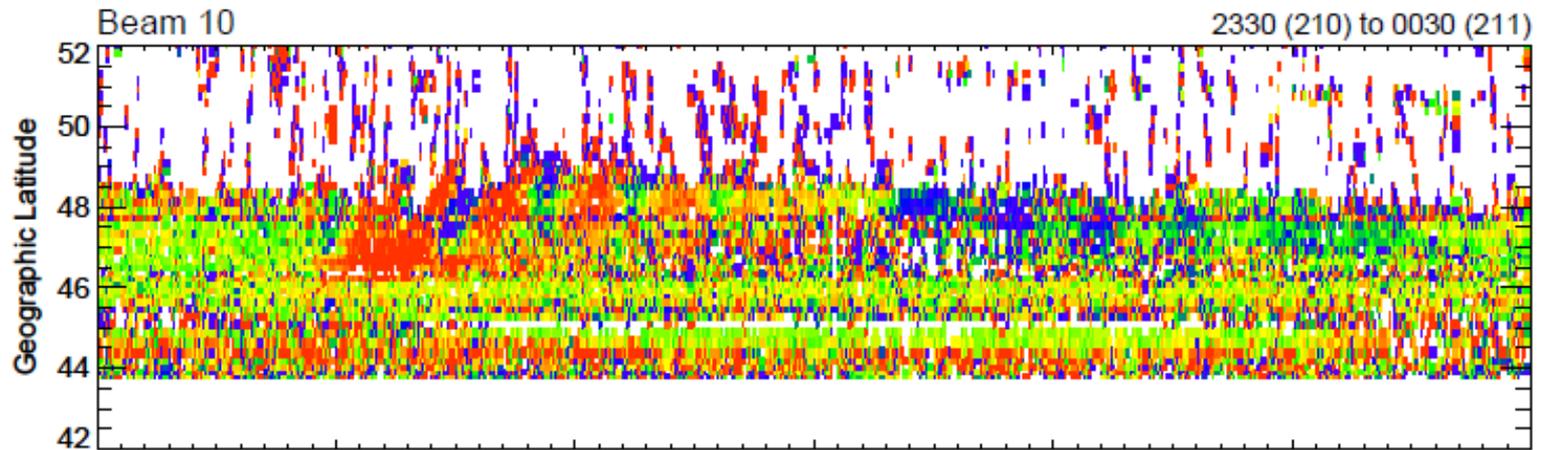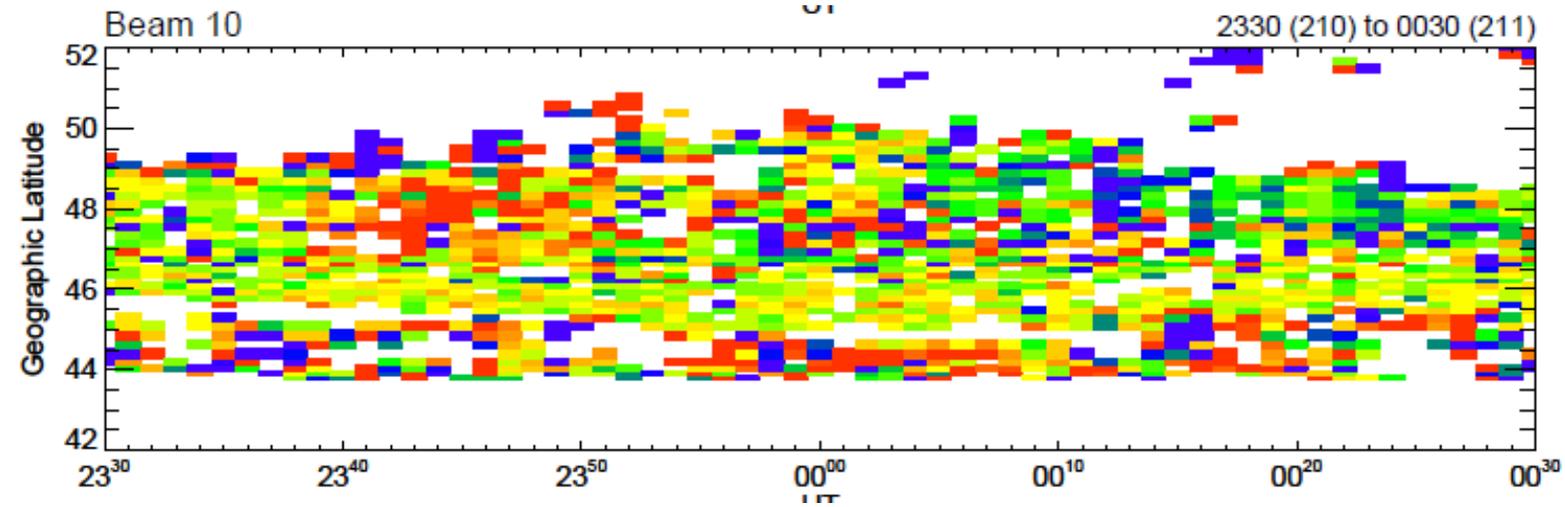
Visiting SuperDARN scientists from foreign countries in 2025 FY

- Dr. Pasha Ponomarenko (Univ. of Saskatchewan, Canada)
  - 2026.2.1-2026.4.30

N. Nishitani (ISEE)、A.S. Yukimatu (NIPR)、SD 2026 LOC

- **SuperDARN International Workshop 2026**
  - **June 08-12, 2026**
  - **Venue: Nagoya University Higashiyama campus (Sakata-Hirata Hall)**
  - **Workshop website: https://cicr.isee.nagoya-u.ac.jp/sd2026/**
  - **Registration is open since February 02**
  - **Early registration deadline: April 2**
  - **Abstract submission deadline: May 06, 2026**
  - **EVERYONE IS WELCOME!**

2026/03/10

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